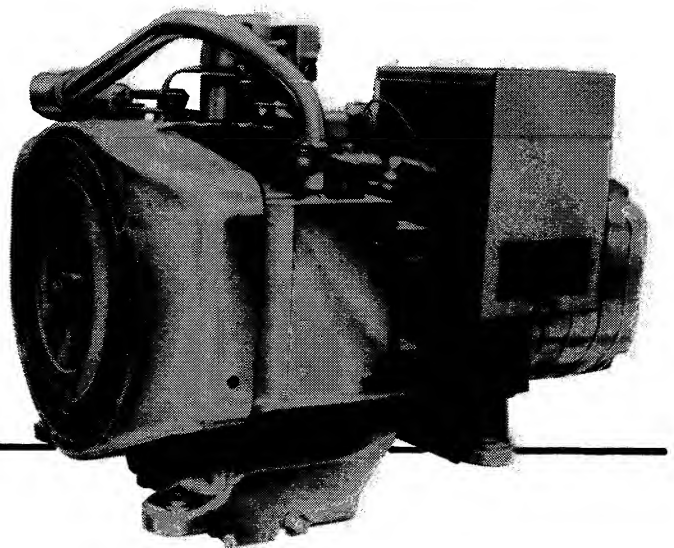


Onan

Operator's Manual

CCK
GenSet



Safety Precautions

Before operating the generator set, read the Operator's Manual and become familiar with it and the equipment. Safe and efficient operation can be achieved only if the unit is properly operated and maintained. Many accidents are caused by failure to follow fundamental rules and precautions.

The following symbols, found throughout this manual, alert you to potentially dangerous conditions to the operator, service personnel, or the equipment.

⚠ DANGER This symbol warns of immediate hazards which will result in severe personal injury or death.

⚠ WARNING This symbol refers to a hazard or unsafe practice which can result in severe personal injury or death.

⚠ CAUTION This symbol refers to a hazard or unsafe practice which can result in personal injury or product or property damage.

FUEL AND FUMES ARE FLAMMABLE. Fire, explosion, and personal injury can result from improper practices.

- DO NOT fill fuel tanks with the engine running unless tanks are outside the engine compartment. Fuel contact with hot engine or exhaust is a potential fire hazard.
- DO NOT SMOKE OR ALLOW AN OPEN FLAME near the generator set or fuel tank. Internal combustion engine fumes are highly flammable.
- Fuel lines must be adequately secured and free of leaks. Fuel connections at the engine should be made with an approved flexible line. Do not use copper piping on flexible lines as copper will work harden and become brittle.
- Be sure that all fuel supplies have a positive shutoff valve.
- DO NOT SMOKE while servicing batteries. Lead acid batteries emit a highly explosive hydrogen gas that can be ignited by electrical arcing or by smoking.

EXHAUST GASES ARE DEADLY

- Provide an adequate exhaust system to properly expel discharged gases. Inspect the exhaust system daily for leaks per the maintenance schedule. See that exhaust manifolds are secure and are not warped. Do not use exhaust gases to heat a compartment.
- Be sure the unit is well ventilated.

MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Keep your hands away from moving parts.
- Before performing any maintenance on the generator set, disconnect the starting battery negative (–) ground lead first. This will prevent accidental starting.
- Make sure that fasteners on the generator set are secure. Tighten supports and clamps, keep guards in position over fans, drive belts, etc.

- Do not wear loose clothing or jewelry while servicing any part of the generator set. Loose clothing and jewelry can become caught in moving parts. Jewelry can short out electrical contacts and cause shock or burning.
- If adjustment *must* be made while the unit is running, use extreme caution around hot manifolds, moving parts, etc.

ELECTRICAL SHOCK WILL CAUSE SEVERE PERSONAL INJURY OR DEATH

- Remove electric power before removing protective shields or touching electrical equipment. Use rubber insulative mats placed on dry wood platforms over floors that are metal or concrete when around electrical equipment. Do not wear damp clothing (particularly wet shoes) or allow skin surfaces to be damp when handling electrical equipment.
- Use extreme caution when working on electrical components. High voltages can cause injury or death. DO NOT tamper with interlocks.
- Follow all state and local electrical codes. Have all electrical installations performed by a qualified licensed electrician. Tag open switches to avoid accidental closure.
- DO NOT CONNECT THE GENERATOR SET DIRECTLY TO ANY BUILDING ELECTRICAL POWER SYSTEM. Hazardous voltages can flow from the generator set into the utility line. This creates a potential for electrocution or property damage. Connect only through an approved device and after building main switch is open. Consult an electrician in regard to emergency power use.

GENERAL SAFETY PRECAUTIONS

- Provide appropriate fire extinguishers and install them in convenient locations. Consult your local fire department for the correct type of extinguisher to use. Do not use foam on electrical fires. Use extinguisher rated ABC by NFPA.
- Used engine oils have been identified by some state or federal agencies as causing cancer or reproductive toxicity. When checking or changing engine oil, take care not to ingest, breathe the fumes, or contact used oil.
- Benzene and lead, found in some gasoline, have been identified by some state and federal agencies as causing cancer or reproductive toxicity. When checking, draining or adding gasoline, take care not to ingest, breathe the fumes, or contact gasoline.
- Make sure that rags are not left on or near the engine.
- Remove all unnecessary grease and oil from the unit. Accumulated grease and oil can cause over heating and engine damage, and present a potential fire hazard.
- Keep the generator set and the surrounding area clean and free from obstructions. Remove any debris from the set and keep the floor clean and dry.
- Do not work on this equipment when mentally or physically fatigued, or after consuming any alcohol or drug that makes the operation of equipment unsafe.

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Introduction

ABOUT THIS MANUAL

This manual contains information for installation, operation, and maintenance of the Onan CCK generator set. Study this manual carefully and observe all warnings and cautions. Using the generator set properly and following a regular maintenance schedule will result in longer unit life, better performance, and safer operation.

HOW TO OBTAIN SERVICE

When the generator set requires servicing, contact an Onan dealer or distributor for assistance. Onan factory trained parts and service representatives are ready to handle all service needs.

A copy of the warranty form and the parts manual are contained in the literature package included with the unit. A service manual is available on special order through the Onan dealer or distributor.

When contacting an Onan dealer or distributor, always supply the complete Model number and Serial number as shown on the Onan nameplate. See Figure 1. The Onan nameplate is located on the side of the receptacle panel.

The Onan nameplate is a rectangular label with a black background and white text. It contains the following information:

- Onan** logo at the top.
- Model and Spec No.** followed by a blank line.
- Serial No.** followed by a blank line.
- Important** note: "Always give above no.'s when ordering parts".
- AC Volts** and **Ph** (Phase) fields.
- KVA** and **kW** fields.
- PF** (Power Factor), **Amps**, and **Hz** (Hertz) fields.
- DCV** (Direct Current Voltage), **Amps**, and **Watts** fields.
- RPM** (Revolutions Per Minute) and **Bat.** (Battery) fields.
- Time Rating** field.
- For Elec** (Electrical) and **Eqpt Only** (Equipment Only) fields.
- Insulation** - NEMA Class **F** Amb 40°C.
- Onan Corp**, **Minneapolis Mn**, **55432 USA**, **Made in USA**.
- 99 0873** at the bottom right.

FIGURE 1. ONAN NAMEPLATE

⚠ WARNING

INCORRECT INSTALLATION OR SERVICE CAN RESULT IN SEVERE PERSONAL INJURY, DEATH, AND/OR EQUIPMENT DAMAGE. INSTALLATION AND SERVICE PERSONNAL MUST BE QUALIFIED TO PERFORM ELECTRICAL AND/OR MECHANICAL SERVICE.

Specifications

NOMINAL DIMENSIONS

	HEIGHT	WIDTH	LENGTH
4.0CCK	20-1/8 in. (511 mm)	19-1/2 in. (495 mm)	26-1/16 in. (662 mm)
4.0CCK with Vacu-flo	19-3/8 in. (492 mm)	19-1/2 in. (495 mm)	29-1/16 in. (738 mm)
5.0CCK	20-1/8 in. (511 mm)	19-1/2 in. (495 mm)	28-7/16 in. (722 mm)
5.0CCK with Vacu-flo	19-3/8 in. (492 mm)	19-1/2 in. (495 mm)	31-7/16 in. (799 mm)
Portable and Contractor's Models	22-7/8 in. (581 mm)	25-5/8 in. (651 mm)	39-1/4 in. (997 mm)

GENERATOR DETAILS*

Rating in Watts (Unity Power Factor)

3.5 CCK	3500
4.0 CCK	4000
5.0 CCK	5000

ENGINE DETAILS

Design	Four-cycle, air-cooled, L-head, horizontally opposed
Number of Cylinders	Two
Engine Speed	
60 Hertz Operation	1800 r/min
50 Hertz Operation	1500 r/min
Ignition	
Standard Models	Battery
Portable and Contractor's Models	Magneto
Starting	
Standard and Contractor's Models	Exciter Cranking (Generator)
Portable Models	Manual (Recoil Pull Rope)

CAPACITIES AND REQUIREMENTS

Oil Capacity	4 qt. (3.8 L) (4.5 qt [4.3 L] with optional oil filter)
Fuel Tank Capacity - Portable and Contractor's Models	4 gal. (15 L)
Battery Electric Start	
Voltage	12 Volts
Rating	360 Cold Cranking Amps (74 A/Hr)
Battery Charge Rate (Fixed Two-Step)	2A and 5A
Cooling - Minimum Vent Sizes	
Pressure Cooled Units	
Inlet Vent	2.5 ft ² (0.233 m ²)
Outlet Vent	5 ft ² (0.465 m ²)
Vac-Flo Units	
Inlet Vent	1 ft ² (929 cm ²)
Outlet Vent	1/6 ft ² (155 cm ²)

Average Fuel Consumption (Full Load)

	Gasoline	Natural Gas	Propane
4.0CCK (60 Hertz)	0.75 gal/h (2.84 L/h)	90 ft ³ /h (2.55 m ³ /h)	40 ft ³ /h (1.13 m ³ /h)
5.0CCK (60 Hertz)	0.88 gal/h (3.33 L/h)	115 ft ³ /h (3.26 m ³ /h)	47 ft ³ /h (1.33 m ³ /h)

TUNE-UP SPECIFICATIONS

Breaker Point Gap (Full Separation)	0.020 inch (0.51 mm)
Spark Plug Gap	
Gasoline Fueled Models	0.025 inch (0.64 mm)
Gaseous Fueled Models	0.018 inch (0.46 mm)

* - See nameplate for voltage, current rating, and other electrical details.

Installation

GENERAL

Read this entire section before installing the generator set. The instructions in this manual should be used only as a guide. Each installation must be considered on an individual basis. Consult your local building inspector for information on local building codes, fire ordinances, etc. before installing your generator set. Proper installation is very important. Some important installation considerations are:

- Adequate cooling air
- Adequate combustion air
- Discharge of exhaust gases
- Discharge of circulated air
- Electrical connections and bonding
- Fuel connections
- Accessibility for operation and servicing
- Level mounting surface
- Noise levels

LOCATION

Permanent Mount

Provide a protected location that is dry, dust-free and, preferably, heated in cold weather. Allow at least 24 inches (610 mm) around the installation for service and maintenance of the unit. Figure 2 illustrates a typical installation for a pressure-cooled generator set.

Portable

Operate the generator set outdoors where the exhaust gases and engine waste heat can be discharged directly into the open air. Do not operate the generator set indoors or in any type of enclosure that may allow exhaust fumes to accumulate. Do not operate the generator set near an open window, door, air intake, or any other place where exhaust gases may enter the interior of a building or vehicle.

⚠ WARNING *Inhalation of exhaust gases can cause severe personal injury or death. DO NOT operate the generator set indoors or near an open window, door, air intake, or other place where exhaust gases can enter the interior of a building. Do not operate generator set in poorly ventilated areas such as confined areas, depressions, or any areas where exhaust gases might accumulate.*

⚠ WARNING *Because a generator set presents the hazard of electrical shock that can cause severe personal injury or death, never expose the generator set to rain, snow, or other similar wet conditions when operating.*

⚠ WARNING *Due to danger of personal injury or death, do not operate the generator set in hazardous areas where it might ignite gases, combustibles, or explosive materials.*

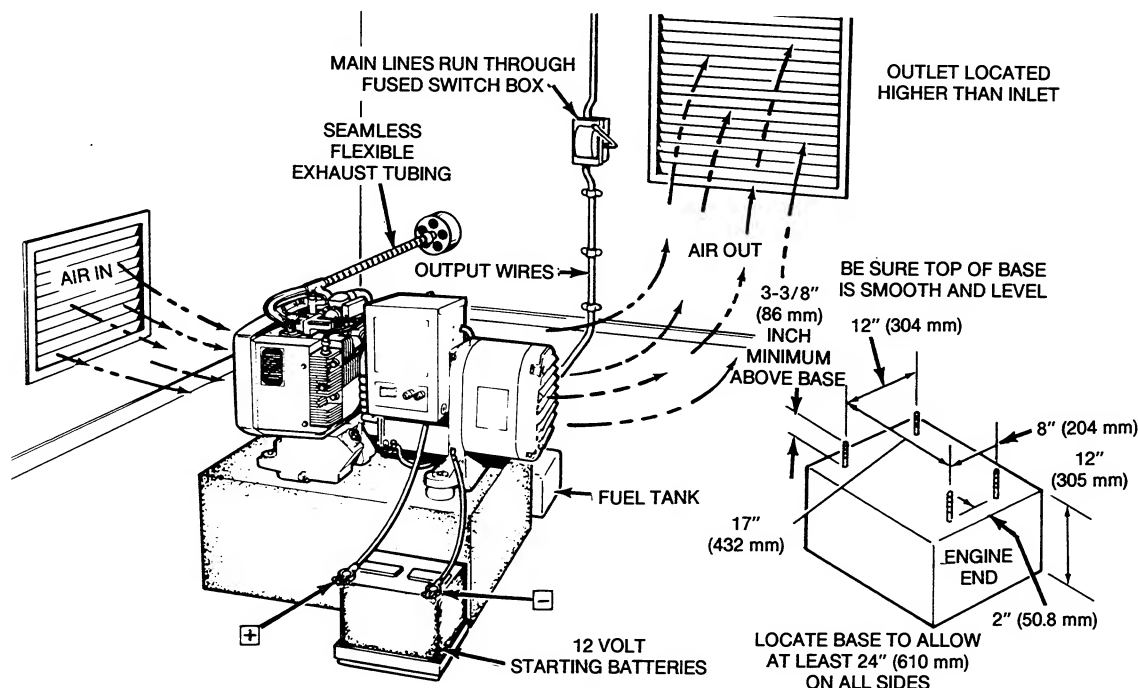


FIGURE 2. TYPICAL CCK GENERATOR SET INSTALLATION

MOUNTING

Permanent installations need a sturdy, level mounting base of concrete, heavy wood, structural steel or other sturdy support at least 12 inches (305 mm) high to aid routine maintenance, operation and service.

Assemble the vibration isolators as shown in Figure 3. The spacer bushing prevents compression of the snubber or upper rubber cushion.

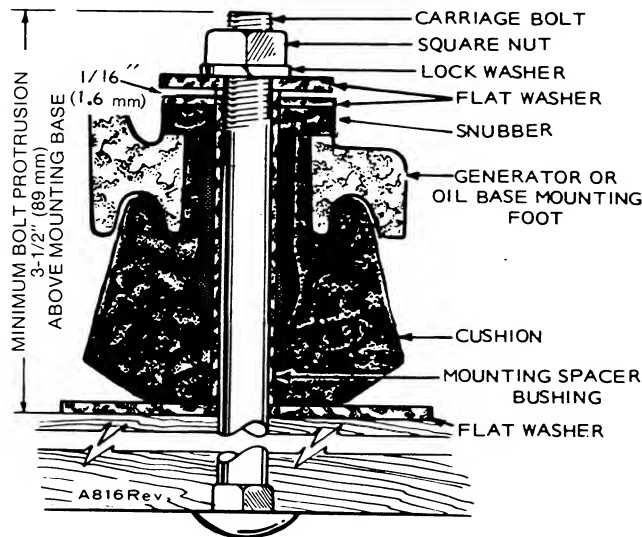


FIGURE 3. VIBRATION ISOLATOR

VENTILATION AND COOLING SYSTEM

General

Air circulation is needed to dissipate heat produced by the engine and generator in normal operation. Outdoor installations can rely on natural circulation, but indoor or housed installations need properly sized and positioned vents for required air flow.

The *Specifications* section of this manual lists minimum inlet and outlet vent sizes for proper ventilation of units installed in enclosed structures. If free air flow is in any way restricted by louvers or screens, increase the vent areas 1/4 to 1/2 times. Prevailing winds may also affect air flow if they consistently blow directly into the outlet vent.

Arrange the vents so air cannot escape without first passing through the immediate area of the installation. Locate the outlet slightly higher than the inlet to allow for convection air flow. Take steps to prevent recirculation of cooling air. If inlet air is more than 10°F (5.9°C) above ambient, recirculation is probably occurring. Inlet air should not exceed 120°F (49°C) when the engine is running at full load.

Vacu-Flo Cooling

The centrifugal fan located in the Vacu-Flo scroll is capable of easily moving the required volume of air if given an adequate source. When a duct is used between the scroll discharge and the outlet vent, it must be flexible enough to allow unit movement and have a free area at least as large as the scroll discharge (Figure 4).

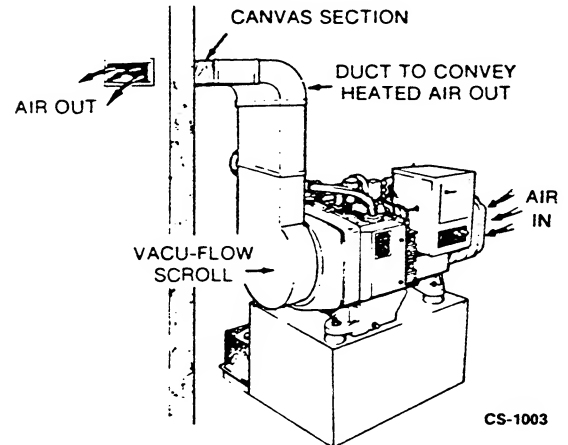


FIGURE 4. VACU-FLO COOLING

A canvas section in the duct prevents the transfer of engine vibrations. Use large radius elbows and increase duct size for runs over 5 feet (1.52 m). A slight upward pitch in the duct allows heat to escape when the engine is shut off and minimizes vapor lock.



Inhalation of exhaust gases can result in severe personal injury or death. Do not use discharged Vacu-Flo air for heating as it may contain poisonous engine exhaust gases.

Thermostatically-Controlled Shutters

These optional shutters can be used to speed warm-up after starting and keeps cold air out during shutdown. The shutters start to open at 120°F (49°C) and are completely open at 140°F (60°C). Onan recommends the optional high temperature shutdown switch be used with air shutters.

EXHAUST SYSTEM

Vent all exhaust gases outside. The exhaust outlet must not terminate near air inlet vents or combustible materials. Avoid sharp bends and use large radius elbows in the exhaust piping. If the piping cannot be pitched downward, install a condensation trap in the system where a rise begins (Figure 5). The exhaust line connects to a 1-inch NPTF outlet at the engine.

⚠ WARNING *Inhalation of exhaust gases can result in severe personal injury or death. Do not use exhaust heat to warm a room, compartment, or storage area.*

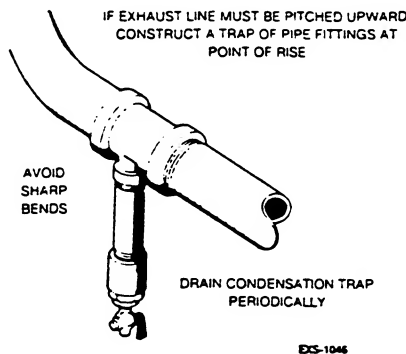


FIGURE 5. EXHAUST CONDENSATION TRAP (TYPICAL)

Exhaust piping must not come closer than 9 inches (229 mm) to combustible material. Where the system leaves the building or enclosure, install a thimble (Figure 6).

⚠ WARNING *Inhalation of exhaust gases can result in severe personal injury or death. Use extreme care during installation to provide a tight exhaust system.*

⚠ WARNING *Contact with hot exhaust components can result in severe burns. Shield or insulate exhaust lines if there is a danger of personal contact.*

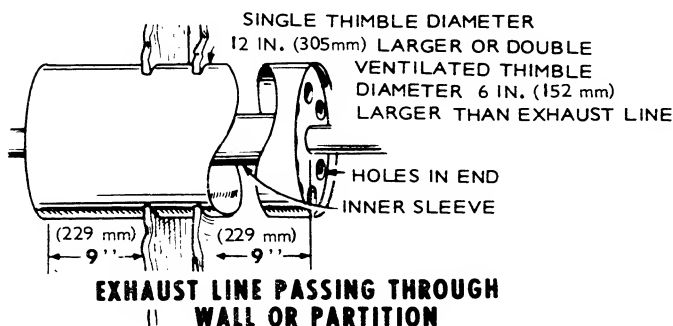


FIGURE 6. EXHAUST THIMBLE

FUEL SYSTEM

Fuel Connection

For gasoline-fueled generator sets, other than the contractor models which have their own fuel tank, connect a fuel line to the fuel pump inlet that is threaded 1/8-inch NPTF (National Pipe Thread Female). Use a flexible line next to the unit to prevent transmission of vibration to the fuel line.

⚠ WARNING *Fuel leaks create fire and explosion hazards which can result in severe personal injury or death. Always use approved flexible tubing between engine and the fuel supply to avoid line failure and leaks due to vibration. The fuel system must meet applicable codes.*

For gaseous-fueled generator sets, check with your local supplier for gas regulations and pressure. See Figure 7. Provide a manual gas shutoff and a "dry gas" filter in the line. Electric solenoid shutoff valves are usually required for indoor automatic or remote starting installations (see *Gas Solenoid Valve* following). Also install a demand-type regulator according to instructions and locate it near the generator set to aid starting (regulator line pressure must be within 2 to 8 ounces or 0.9 to 3.4 kPa).

Always use flexible tubing between the engine and gas-demand regulator. Use the shortest possible hose between the regulator and carburetor for best starting.

Seal gas line connections with shellac or some other compound approved for use in gaseous fuel systems. Thread-sealing compounds with a lead base are not satisfactory.

⚠ WARNING *Fuel presents the hazard of fire or explosion which can result in severe personal injury or death. Do not permit any flame, spark, pilot light, cigarette or other ignition source near the fuel system.*

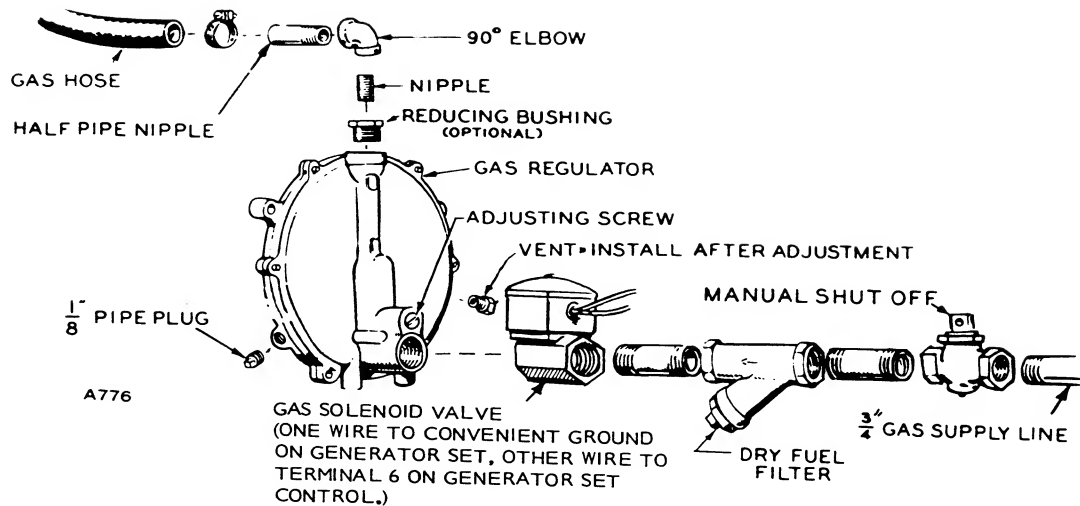


FIGURE 7. CONNECTIONS FOR GAS LINE

Gas Solenoid Valve

Connect one wire lead to terminal 6 on the terminal block located inside the generator set control box. See Figure 8. If the solenoid valve does not ground directly to the generator set, connect a common wire ground from the valve to the generator set.

Gas Vacuum Switch (When Used)

If a vacuum switch is used in conjunction with the gas solenoid valve, first connect one wire of the gas solenoid to ground of the generator set and the other solenoid lead to terminal "C" of the vacuum switch (located on the intake manifold). See Figure 8. The terminal marked "NC" on the vacuum switch connects to the terminal marked "B" on the voltage regulator located inside the generator set control box. Terminal "NO" of the vacuum switch connects to terminal 6 on the terminal block inside the control box.

Gasoline Tank

If a separate fuel tank is used, install the tank so its bottom is less than 4 feet (1.22 m) below the fuel pump. The tank top must also be below the fuel pump level to prevent siphoning. If the fuel tank is shared with another engine, use a separate fuel line.

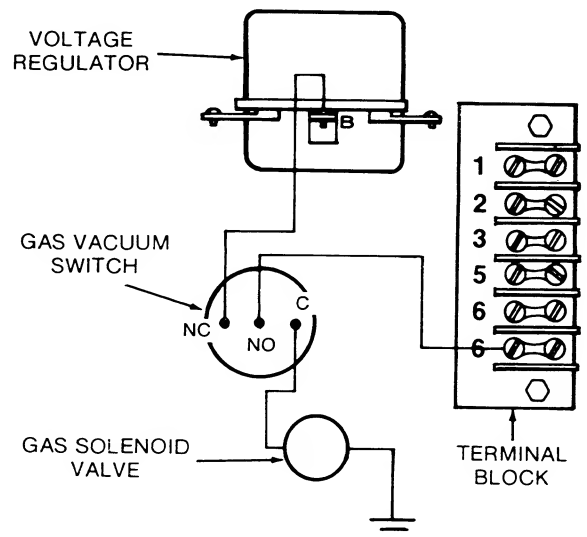


FIGURE 8. VACUUM SWITCH CONNECTIONS

ELECTRICAL CONNECTIONS

General

Installing the generator set electrical system includes installing line breakers, connecting the load, installing the remote start control (if used), and connecting the batteries. If using an Onan transfer switch, refer to the transfer switch Operator's manual for electrical connections. The batteries must always be connected last to avoid accidental starting of the unit during installation.

⚠WARNING *Accidental starting of the generator set during installation creates a hazard of serious personal injury or death. Do not connect the starting batteries until instructed to later in this section.*

Grounding Requirements

Always ground the set per the instructions of your local electrical inspector and the National Electrical Code. Typically, this consists of connecting a #8 AWG or larger wire between:

1. A separate ground pipe or rod penetrating at least 8 feet (2.8 m) into moist earth, and ...
2. The solderless connector located on the control box (Figures 14 and 15).

⚠WARNING *Contact with electrically "hot" equipment can result in severe personal injury or death. It is extremely important that bonding and equipment grounding be properly done. All metallic parts which could become energized under abnormal conditions must be properly grounded.*

⚠WARNING *If faulty electrical equipment is connected to the generator, an electrical shock hazard exists which can result in severe personal injury or death. Check all electrical equipment for frayed cords or breaks in the insulation before using.*

Properly applied and maintained ground fault circuit interrupters, often required by local codes, can afford additional protection against the hazard of electrical shock.

Load Wire Connections

AC output wires are located in the compartment at the rear of the set control box (Figure 14). Remove the control box cover to gain access. Installation should be made by a qualified electrician and inspected by the local building inspector to be sure it meets all applicable code requirements.

Use flexible conduit and stranded load wires near the set to absorb vibration. Use sufficiently large insulated wires. Strip the insulation from the wire ends as necessary for clean connections. Connect each load wire to the proper generator output lead inside the AC output box. Insulate the bare ends of ungrounded wires. Install a fused main switch (or circuit breaker) between the generator set and the load.

⚠WARNING *Improper wiring can result in fire and severe personal injury or death. Do not connect electrical wiring to the fuel line.*

Reconnectable, Single-Phase Generator

Voltage selection on reconnectable single-phase generators is for use as 120/240 volts, 3 wire; 120 volts, 2 wire; or 240 volts, 2 wire (Figure 9). Use the connection for two-wire service when one load exceeds one-half the rated capacity. Balance the load when connecting for three-wire service. Current for any one output lead must not exceed nameplate rating. Serious overloading can damage the generator windings. When two or more single-phase circuits are available, divide the load equally between them.

Three-Phase, Four-Wire, Wye Connected Generators

A three-phase, four-wire generator set produces a single-phase current of one voltage and three-phase current of a different voltage. The single-phase voltage is the lower voltage as noted on the nameplate, and the three-phase voltage is the higher nameplate voltage. See Figure 10.

The output lead marked M0 is grounded. For single-phase current, connect the neutral (white) load wire to the M0 lead. Connect the "hot" (black) load wire to any one of the other three output leads ... M1, M2 or M3.

Three separate single-phase circuits are available, with not more than one-third the rated capacity of the generator set from any one circuit.

For three-phase current, connect separate load wires to each of the generator leads M1, M2 and M3. Single-phase current of the higher nameplate voltage is obtained between any two three-phase leads. If single-phase and three-phase currents are used at the same time, use care to properly balance the single-phase load.

⚠CAUTION *An overcurrent condition can cause damage to equipment. Any combination of single-phase and three-phase loads may be used as long as the current in each line of the generator does not exceed rated current.*

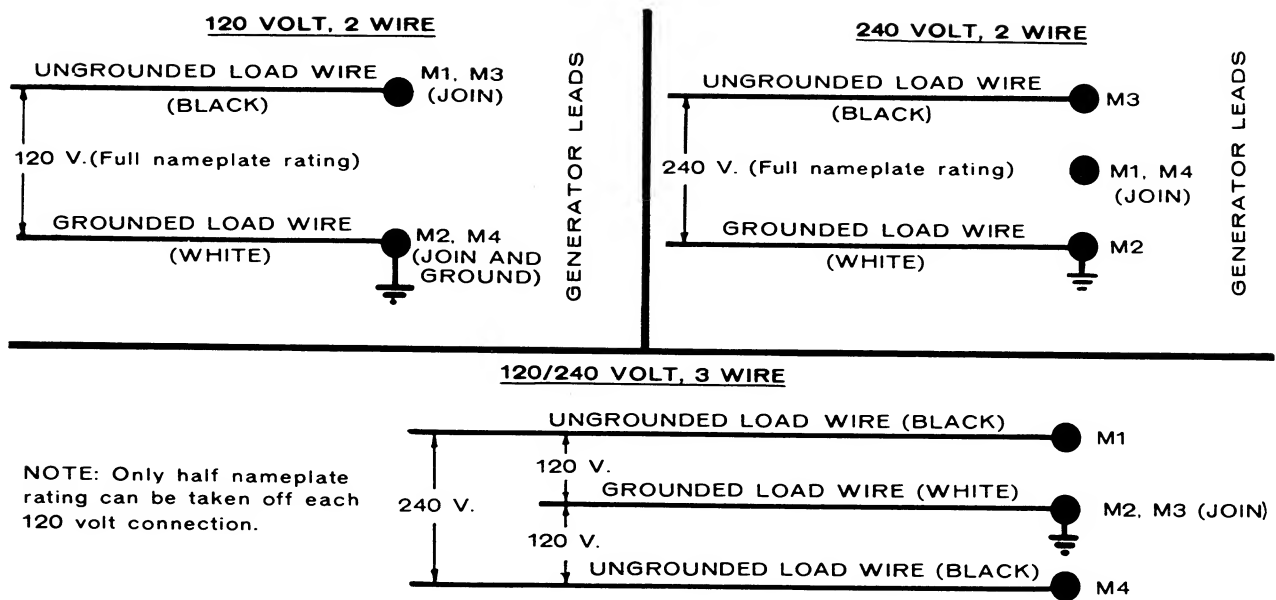


FIGURE 9. SINGLE-PHASE, VOLTAGE CODE "3C" GENERATOR CONNECTIONS

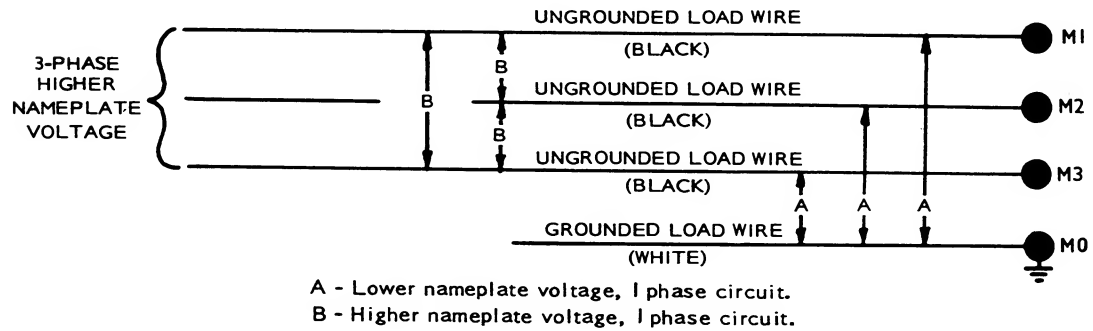


FIGURE 10. WYE GENERATOR CONNECTIONS FOR VOLTAGE CODES -4 and -4x

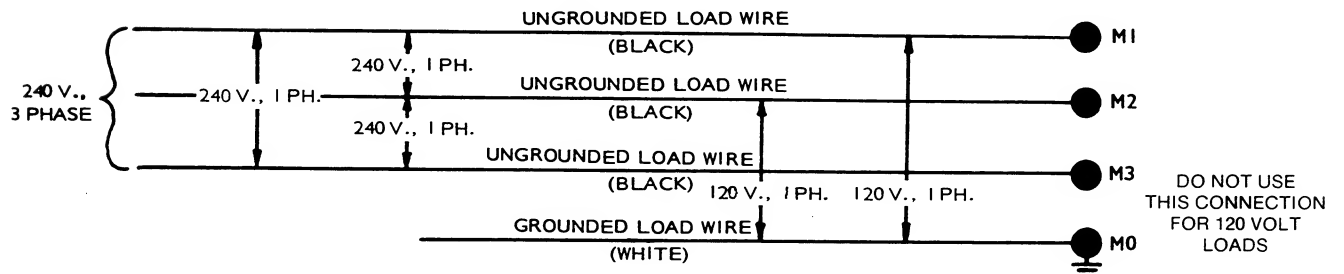


FIGURE 11. DELTA GENERATOR CONNECTIONS FOR VOLTAGE CODE-5D

120/240-Volt, Three-Phase, Four-Wire Delta Connected Generator

Three-phase delta connected generator sets are designed to supply 120-volt, single-phase current; 240-volt, single-phase current; or 240-volt, three-phase current. See Figure 11.

For three-phase operation, connect the three load wires to the three output leads M1, M2 and M3 ... one wire to each terminal. M0 is the neutral wire and is not used for three-phase operation.

Connect the "hot" (black) load wire to either the M1 or M2 lead for 120-volt, single-phase service. Connect the neutral (white) wire to the M0 terminal. Two 120-volt circuits are available.

CAUTION *An overvoltage condition can cause damage to equipment. DO NOT use M0 and M3 as a 120-volt circuit on Delta models. This connection provides approximately 190 volts and it could damage 120-volt loads.*

For single-phase, 240-volt service, connect the load circuit between M1 and M2, or between M2 and M3, or between M1 and M3 (three circuits available). The M0 lead is not used. Any combination of single-phase and three-phase loading can be used at the same time as long as no lead current exceeds the nameplate rating of the generator.

Single-phase loads up to two-thirds of the three-phase rating can be used if there is no other load on the generator.

Balancing the Load

Current for any one output lead must not exceed nameplate rating. Serious overloading can damage the generator windings. When two or more single-phase circuits are available, divide the load equally between them.

Switchboard

When an optional wall mounted switchboard containing ammeters, voltmeters and circuit breakers is used, these load wire connections apply: Connect one ungrounded (hot) generator lead to the unused terminal of each ammeter. Connect any generator leads and lead wires which are to be grounded to the ground stud in the switchboard. On sets that generate more than one voltage, the voltmeter reads the higher voltage shown on the nameplate. The lower voltage is correct when the higher voltage is correct.

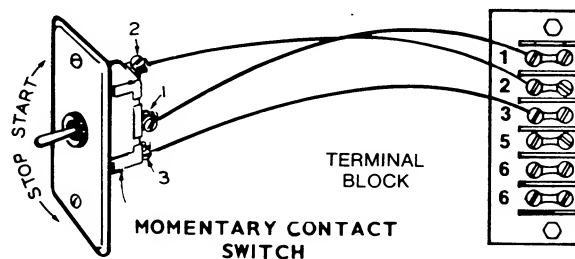
Standby

If the installation is for a standby power application, install a double-throw transfer switch (either manual or automatic) to prevent feeding generator output into the normal power source lines and to also prevent com-

mercial power and generator output from being connected to the load at the same time. Instructions for connecting an automatic load transfer switch are included with such equipment.

Connections for Remote Monitoring

Start-Stop Switch: For remote starting and stopping, use three wires to connect the remote switch (SPDT, momentary contact, center-off type) to the terminal block in the set control box (Figure 12).



WIRE SIZE	DISTANCE
#18	to 125 ft. (38 m)
#16	to 200 ft. (61 m)
#14	to 300 ft. (91 m)
#12	to 500 ft. (152 m)

FIGURE 12. REMOTE CONNECTIONS

DC Voltmeter: When using a DC voltmeter to monitor battery condition, connect one wire to terminal 1 (-) and the other to terminal 5 (+) of the control box terminal block. Use number 18 AWG or larger wire (Figure 13).

Running Time Meter: Connect the running time meter, when used, to terminals 1 and 6 of the control box terminal block, using number 18 AWG or larger wire (Figure 13).

12-Volt Generating Lamp: If a 12-volt generating lamp is used, connect it to terminals 1 and 6 on the control box terminal block. See Figure 13.

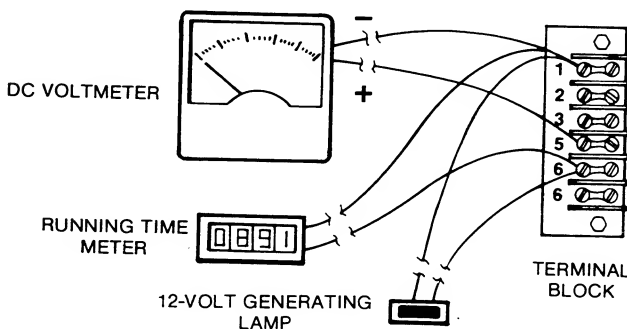


FIGURE 13. CONNECTION OF DC VOLTMETER, RUNNING TIME METER AND 12-VOLT GENERATING LAMP.

BATTERY CONNECTIONS

Standard Models

Remove the cover from the control box and connect the positive (+) battery cable to the terminal marked "BAT" on the start solenoid (Figure 14). Connect the negative (-) cable to the generator through-bolt, as shown. Always connect the positive cable first to minimize the possibility of arcing.

If the battery connections are accidentally reversed, the engine will start and run, but have no battery charging capability.

⚠ WARNING Ignition of explosive battery gases can cause severe personal injury. Do not smoke while servicing batteries.

⚠ WARNING Sparks can ignite battery gases and result in an explosion and severe personal injury. Do not disconnect battery cables while generator set is cranking or running.

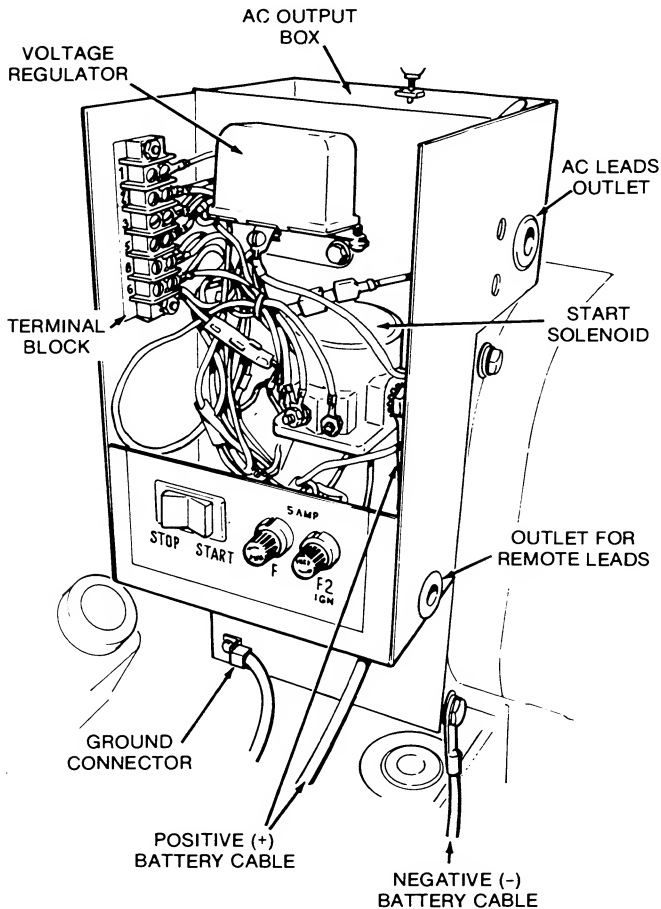


FIGURE 14. CONTROL BOX CONNECTIONS
STANDARD MODELS

Contractor Models

Remove the cover panel for the outlet receptacles by taking out the four screws (Figure 15). Connect the positive (+) battery cable to the unused terminal on the start switch. Connect the negative (-) battery cable to the generator through-bolt as shown.

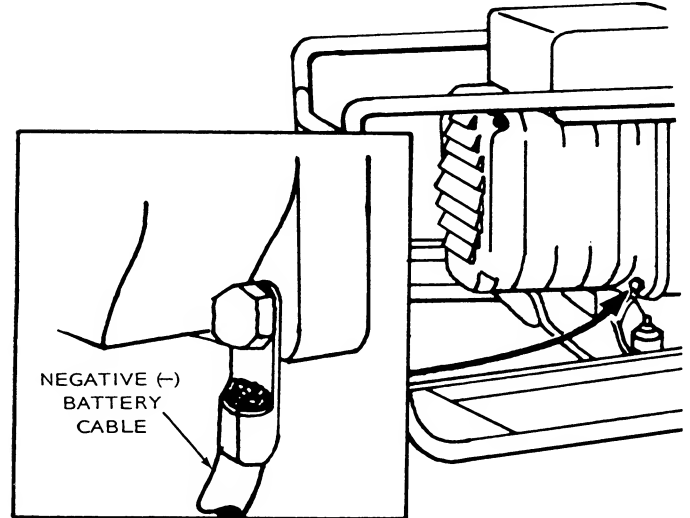


FIGURE 15. BATTERY AND GROUND CONNECTIONS -
CONTRACTOR AND PORTABLE MODELS

Operation

⚠ WARNING

EXHAUST GAS IS DEADLY!

Exhaust gases contain carbon monoxide, an odorless and colorless gas. Carbon monoxide is poisonous and can cause unconsciousness and death. Symptoms of carbon monoxide poisoning can include:

- Dizziness
- Nausea
- Headache
- Weakness and Sleepiness
- Throbbing in Temples
- Muscular Twitching
- Vomiting
- Inability to Think Coherently

IF YOU OR ANYONE ELSE EXPERIENCE ANY OF THESE SYMPTOMS, GET OUT INTO THE FRESH AIR IMMEDIATELY. If symptoms persist, seek medical attention. Shut down the unit and do not operate until it has been inspected and repaired.

Protection against carbon monoxide inhalation includes proper installation and regular, frequent visual and audible inspections of the complete exhaust system.

1-P/EM

GENERAL

This section covers starting and operating the generator set. It is recommended that the operator read through this entire section before attempting to start the set. It is essential that the operator be completely familiar with the set for safe operation.

PRE-START CHECKS

Before starting, be sure the following checks have been made and the unit is ready for operation. Refer to the *Maintenance* section for the proper procedures.

Engine Oil

Make sure the generator set is level when you are checking the engine oil. Otherwise, you will have an inaccurate oil level indication. Keep oil level near as possible to the dipstick full mark. Do not overfill.

⚠ WARNING **Crankcase pressure can blow out hot oil and cause serious burns. Do not attempt to check oil while the generator is running.**

Fuel

Make sure the fuel tanks are full. See "Recommended Fuels" following.

⚠ WARNING **Fuel presents the hazard of fire or explosion which can cause severe personal injury or death. Never fill the fuel tank when the engine is hot or running. Do not permit any flame, spark, pilot light, cigarette or other ignition source near the fuel system.**

RECOMMENDED FUELS

Gasoline

Use clean, fresh, unleaded or regular grade gasoline. Using unleaded gasoline results in extended periods between service, longer spark life, and reduced carbon clean-out maintenance. If regular gasoline is used, lead deposits must be removed from the cylinder heads as required to reduce engine power loss. Unleaded gasoline can be used safely after regular gasoline usage if lead deposits have been removed from the cylinder head areas.

⚠ CAUTION **Alternating between unleaded and leaded (regular) gasoline can result in engine damage unless lead deposits are removed from the cylinder head areas before using unleaded gasoline again.**

Liquid Propane Gas

Use clean, fresh commercial propane or HD-5 grade liquid propane gas in a mixture of at least 90 percent propane. Propane fuels other than HD-5 can contain more than 2.5 percent butane which can result in poor fuel vaporization and poor engine starting in low ambient temperatures (below 32°F or 0°C).

A manual shutoff valve must be mounted on the propane fuel supply tank. This supply tank valve must be opened fully when operating the generator set so that the excess flow valve will close with a broken propane fuel line.

STARTING AND STOPPING

The following sections cover starting and stopping the generator set.

Give the generator set a visual inspection for loose bolts and nuts, oil leaks, fuel leaks, and exhaust leaks. Repair any problems before starting the generator set.

New engines sometimes fail to start because the rust inhibitor oil used at the factory during assembly may have fouled the spark plugs. Remove the spark plugs and clean in a suitable solvent. Dry the plugs thoroughly and reinstall. Heavy exhaust smoke when the engine is first started is normal and is caused by the rust inhibitor oil.

Standard Models

1. Push the start-stop switch on the generator set controls to "START". Release the switch as soon as the engine starts.
2. Stop the generator set by pushing the start-stop switch to "STOP." Hold closed until generator set stops.

Contractor's Models

This model has electric starting and a pull rope recoil starter for manual starting if the battery charge condition is too low for cranking.

1. Close the manual choke about three-quarters or as necessary according to temperature conditions.

If the generator set has run out of fuel, it may be necessary to remove the engine hood and operate the fuel primer a few times. See Figure 16.

2. Push the "START" button. Release the button as soon as the engine starts.
3. To stop, push and hold the "STOP" button until the engine is completely stopped.

If manual starting is required, use procedure for portable models.

Portable Models

1. Close the manual choke about three-quarters of the way or as necessary according to temperature conditions.

If the set has run out of fuel, it may be necessary to remove the engine hood and operate the fuel primer a few times. See Figure 16.

2. With a firm grip on the recoil starter handle, pull the rope out quickly and evenly. Do *not* jerk.
3. To stop, push and hold the "STOP" button until the engine is completely stopped.

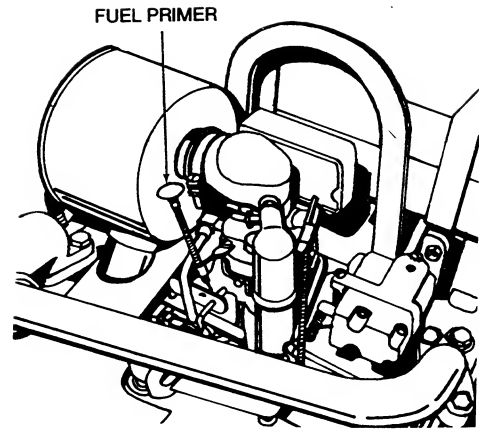


FIGURE 16. FUEL PRIMER ON PORTABLE AND CONTRACTOR'S MODELS

Automatic Shutdown

An optional high temperature switch is available with Vacu-Flo models that shuts down the unit when air temperatures exceed the maximum safe operating limit. The engine cannot be restarted until it has cooled.

CCK Remote Start models have a low oil pressure safety switch which shuts down the set if oil pressure drops below the minimum allowable limits. A low oil level in the crankcase will cause the set to shutdown. Portable and Contractor models do NOT have a low oil pressure safety switch but may have an oil pressure gauge instead.

CONNECTING A LOAD

If practical, allow the generator set to warm up before connecting a load. The generator set maximum power output is stamped on the nameplate. Do not exceed the maximum power output rating by connecting too many loads.

⚠ WARNING **DO NOT CONNECT GENERATOR SET DIRECTLY TO ANY BUILDING ELECTRICAL SYSTEM.** Hazardous voltages can flow from the generator set into the utility line. This creates a potential for electrocution or property damage. Connect only through an approved device and after building main switch is open. Consult an electrician in regard to emergency power use.

⚠ CAUTION **Continuous overloading will cause high operating temperatures that can damage the generator set. Keep load within the generator set rating.**

To determine if the load is within the maximum power output rating of the generator set, add up the wattage requirements of all the electrical loads that will be operated simultaneously. Most appliances or tools have the wattage requirements imprinted on the nameplate. Table 1 can be used as a guide if the wattage requirements are not listed on the equipment. The total should be LESS than the maximum power output rating of the generator set. See Derating section for factors that affect the maximum power output.

**TABLE 1.
POWER REQUIREMENTS FOR APPLIANCES**

Appliance or Tool	Approximate Running Wattage
Air Conditioner	800-4000
Attic Fan	375
Battery Charger	Up to 800
Broiler	1325
Clothes Dryer	4500
Clothes Washer	250-1000
Coffee Percolator	550-700
Dishwasher (conventional)	300
Dishwasher (heating element)	1150
Electric Blanket	50-200
Electric Broom	200-500
Electric Drill	250-750
Electric Frying Pan	1000-1350
Electric Iron	500-2000
Electric Saw	400-1500
Electric Stove (per element)	350-1000
Electric Water Heater	1000-1500
Electric Water Pump	500-600
Freezer	300-1000
Furnace Fan	225
Garbage Disposal Unit	325
Hair Dryer	350-500
Microwave Oven	1000-1500
Oil Burner	250
Radio	50-200
Refrigerator	600-1000
Space Heater	1000-1500
Sump Pump	250-500
Television	200-600
Vacuum Cleaner	500-1500
Well Water Pump	250-1000

Derating

The generator set maximum power output is based on operation at sea level at 60°F ambient temperature. When the generator set is operated at altitudes above sea level or at temperatures above 60°F, the power rating must be derated. The reduction in the power rating is necessary to compensate for the reduction in engine horsepower that occurs at higher altitudes or higher temperatures.

A general rule applies for derating a generator set because of changes in temperature or altitude. A one percent derating can be expected for every 10°F rise in temperature above 60°F (16°C). A 3.5 percent deration can be expected for every 1000 foot increase in altitude above sea level.

For example: A 5000 watt generator operating at 80°F (27°C) ambient temperature and at 3000 feet above sea level should be derated by 12.5 percent or 625 watts.

$$5000-625=4375 \text{ (derated power output)}$$

BREAK-IN PROCEDURE

Controlled break-in with the proper oil and a conscientiously applied maintenance program will help to provide satisfactory service from your generator set. Break-in is as follows:

1. One half hour at 1/2 load. Refer to Table 1 for approximate wattages of common appliances.
2. One half hour at 3/4 load.
3. Change crankcase oil after the first 25 hours of operation.
4. Use regular grade leaded gasoline for the first 25 hours of operation then use unleaded gasoline.

The generator set is designed to operate with a load applied. When possible, avoid running the generator set for extended periods of time without a load, especially during the first 50 hours of operation. Failure to follow the recommended break-in procedure may result in poor piston ring seating.

GENERATOR SET EXERCISE

Exercising the generator set will keep the engine parts lubricated, maintain fuel prime, and provide reliable starts. Each week, run the set with load for a minimum of 30 minutes so normal operating temperatures are reached. Run longer if battery needs charging, or keep battery charged with a separate charger. Exercising for one long period each week is better than several short periods.

HIGH/LOW OPERATING TEMPERATURES

The generator will operate satisfactorily in both high and low temperatures. Use the oil recommended in the *Maintenance* section for the expected temperature conditions.

High Operating Temperatures

1. See that nothing obstructs airflow to and from the generator.
2. Keep cooling fins clean. Cylinder air housings should be properly installed and undamaged.
3. Keep ignition timing properly adjusted.

Low Operating Temperatures

1. Use fresh gasoline and keep the tank filled to avoid condensation.
2. Keep the spark plug clean and correctly gapped.

EXTREMELY DUSTY OR DIRTY CONDITIONS

Observe the following when operating the generator set in extremely dusty or dirty conditions:

1. Keep unit clean. Keep cooling surfaces clean.
2. Service air cleaner as frequently as necessary.
3. Change crankcase oil every 50 operating hours.
4. Keep oil and gasoline in dust-tight containers.
5. Keep governor linkage clean.

Maintenance

Establish and adhere to a definite schedule for maintenance and service. If the generator set is subjected to extreme operating conditions, you should reduce the intervals accordingly.

Consult your Onan dealer if the generator set will be subjected to any extreme operating conditions and determine a suitable maintenance schedule. Keep an accurate log of all service and maintenance performed for warranty support.

Perform all the maintenance at the time period indicated or after the number of operating hours indicated, whichever comes first. Use the schedule to determine the maintenance required, and then refer to the sections that follow for the correct procedures.

⚠ WARNING *Accidental starting of the generator set during maintenance procedures can cause severe personal injury or death. Disconnect the generator set starting battery ground (-) cable before performing maintenance.*

⚠ WARNING *A hot generator set can cause severe burns. Always allow the generator set to cool before performing maintenance.*

TABLE 2. PERIODIC MAINTENANCE SCHEDULE

SERVICE THESE ITEMS	Interval				
	Daily or after 8 Hours	50	100	200	400
General Inspection	x ¹				
Check Oil Level	x				
Check Battery (if so equipped)		x			
Clean Governor Linkage		x ²			
Change Crankcase Oil			x ³		
Change Oil Filter (if used)			x ³		
Check Breaker Points			x ⁴		
Check Spark Plugs			x ⁴		
Clean Engine Cooling Fins			x ²		
Service Air Cleaner (Oil Bath)			x ²		
Replace Air Cleaner Element (Dry)				x ²	
Clean Crankcase Breather				x	
Replace Breaker Points				x	
Clean Fuel Filter (if used)				x	
Adjust Valve Lash					x ⁵
Check Battery and Recharge	Monthly				
Clean Alternator Brushes	Yearly ⁵				

¹ - Check for oil, fuel, and exhaust system leaks.

Check exhaust system audibly and visually with set running and repair any leaks immediately. Replace corroded exhaust and fuel line components before leaks occur.

² - Perform more often in extremely dusty or dirty conditions.

³ - Change oil and filter every 100 hours or 3 months, whichever occurs first. Reduce schedule for dusty or dirty operation conditions.

⁴ - Replace annually or prior to storage.

⁵ - Contact an authorized service center for service.

SET INSPECTION

During operation, be alert for mechanical problems that could create unsafe or hazardous conditions. The following sections cover several areas that should be frequently inspected to provide continued safe operation.

Exhaust System

With the generator set operating, inspect the entire exhaust system including the exhaust manifold, exhaust elbow, muffler and exhaust pipe. Visually and audibly check for leaks at all connections, welds, gaskets, and joints. If any leaks are detected, have them corrected immediately.

⚠ WARNING *Inhalation of exhaust gases can result in severe personal injury or death. Inspect exhaust system audibly and visually for leaks daily. Repair any leaks immediately.*

Fuel System

With the generator set operating, inspect the fuel supply lines and fittings for leaks. Check any flexible sections for cuts, cracks and abrasions and make sure they are not rubbing against anything that could cause breakage.

⚠ WARNING *Leaking fuel will create a fire hazard which can result in severe personal injury or death if ignited by a spark. If any leaks are detected, have them corrected immediately.*

DC Electrical System

With the generator set off, check the terminals on the battery for clean and tight connections. Loose or corroded connections create resistance which can hinder starting. Clean and reconnect the battery cables if loose. Always connect the negative battery cable last to reduce the possibility of arcing.

⚠ WARNING *Ignition of explosive battery gases can cause severe personal injury. Do not smoke while servicing batteries.*

Mechanical

With the generator set stopped, check for loose fittings, leaking gaskets and hoses, or any signs of mechanical damage. If any problems are found, have them corrected immediately. With the set running, listen for any unusual noises that may indicate mechanical problems and check the oil level frequently. Investigate anything that indicates possible mechanical problems.

LUBRICATION SYSTEM

The engine oil was drained from the crankcase prior to shipment. Before the initial start, the lubrication system must be filled with oil of the recommended classification and viscosity. Refer to the *Specifications* section for the lubricating oil capacity.

Oil Recommendations

For engines operating on gasoline, use oil with the API (American Petroleum Institute) designation SE or SE/CC. Oil should be labeled as having passed MS Sequence Tests (also known as having passed ASTM-G-IV Sequence Tests). Refer to Figure 17 for recommended viscosity according to temperature. **For gaseous fuel operation, use an ashless or low-ash detergent oil specifically made for gaseous fueled engines.**

Oil consumption may be higher with a multigrade oil than with a single-grade oil if both oils have comparable viscosities at 210°F (99°C). Therefore, single grade oils are generally more desirable unless anticipating a wide range of temperatures.

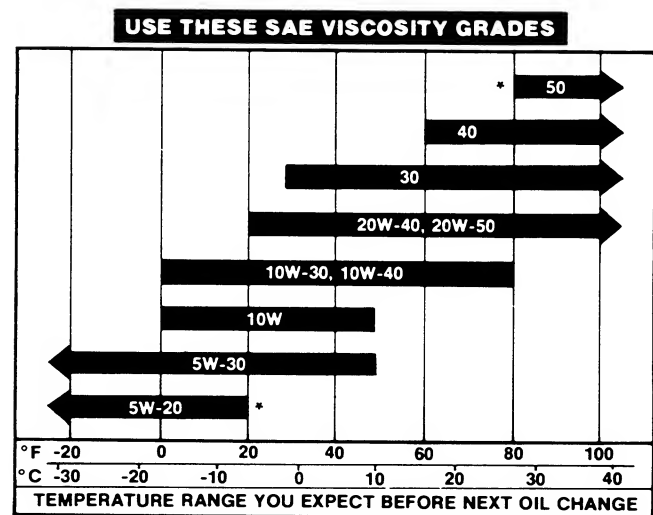


FIGURE 17. OIL SELECTION CHART

OIL LEVEL

To check oil level, screw oil cap down then unscrew and remove to read oil level indicator (see Figure 18).

Check the oil level daily or at least every eight hours of operating time. Check more often on a new unit as oil consumption is higher until the piston rings seat properly.

⚠ WARNING *Crankcase pressure can blow out hot oil and cause serious burns. Do NOT check oil while the generator set is operating.*

⚠ CAUTION *Do not operate the engine with the oil level below the low mark or above the high mark. Overfilling can cause foaming or aeration of the oil while operation below the low mark may cause loss of oil pressure.*

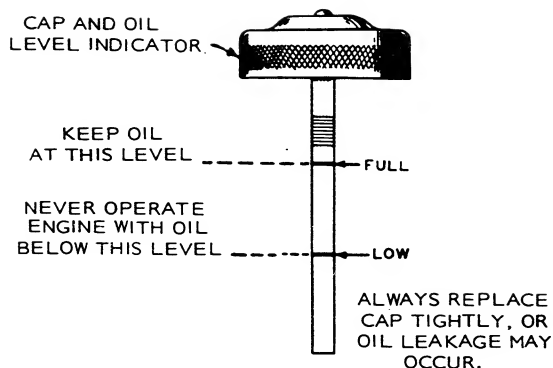


FIGURE 18. CHECKING OIL LEVEL

Oil Change

Initial oil change should be made after the first 50 operating hours; change every 100 hours after that (or 3 months, whichever occurs first). If operating in extremely dusty conditions or in cold weather, change oil more frequently.

Do not mix brands nor grades of motor oil. Use only a good quality oil with the designation SE/CC. If necessary to add oil between changes, use the same brand and grade of oil as is already present in the crankcase.

⚠ WARNING *Hot crankcase oil can cause burns if it is spilled or splashed on skin. Keep fingers and hands clear when removing the oil drain plug and wear protective clothing.*

OIL FILTER (OPTIONAL)

Change the crankcase oil filter every 100 hours; change more frequently in extremely dusty conditions. Remove the filter by turning counterclockwise with a filter wrench. Before installing a new filter, coat the gasket on the filter base with a light film of new oil. Install by turning clockwise until a light friction is noted, then turn an additional 1/2 turn.

⚠ CAUTION *Overtightening the filter can damage the gasket. Do not overtighten the filter as damage may occur to the rubber gasket which will cause the filter to leak. Be sure to install sealing ring around the filter; this ring is an air seal to prevent cooling air loss.*

COOLING SYSTEM

The generator set is cooled by a flywheel blower fan which pulls air through the generator and over the cylinders and cooling fins. The air path is directed by sheet metal shrouds and plates. The shrouds and plates must always be installed properly so the unit does not overheat.

Check and clean the cooling fins at least every 100 hours of operation. Remove any dust, dirt or oil which may have accumulated. Check the air inlet and air outlet for buildup of dirt, etc.

AIR CLEANER

Proper maintenance of the air cleaner is extremely important. Negligence of regular routine maintenance will result in reduced engine life.

For the oil-bath air cleaners, remove the oil cup on the bottom of the air breather (Figure 19). Every 100 hours, empty existing oil, and thoroughly clean cup and screen in a suitable solvent. Dry the cup and screen, fill cup with oil (same weight oil as in crankcase) to oil level mark.

Portable and contractor model generator sets have a replaceable air cleaner cartridge. Remove the cartridge and shake out every 50 hours. Remove the foam wrap, clean with mild detergent and luke warm water, squeeze dry, and reinstall. After 200 hours of operation, remove the air cleaner cartridge element and replace with a new one.

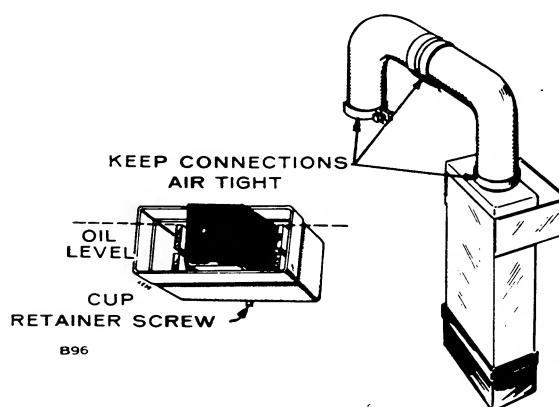


FIGURE 19. OIL BATH AIR CLEANER

CRANKCASE BREATHER

Lift off the rubber breather cap and carefully pry valve from cap (Figure 20). Wash and rinse the whole valve in a suitable solvent. Dry the valve and re-insert. Be sure the valve flapper is toward the engine.

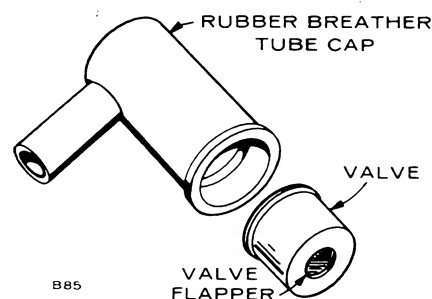


FIGURE 20. CRANKCASE BREATHER

GOVERNOR LINKAGE

The linkage must be able to move freely through its entire travel. Every 50 hours of operation, clean the joints and lubricate as shown in Figure 21. Also inspect the linkage for binding, excessive slack and wear.

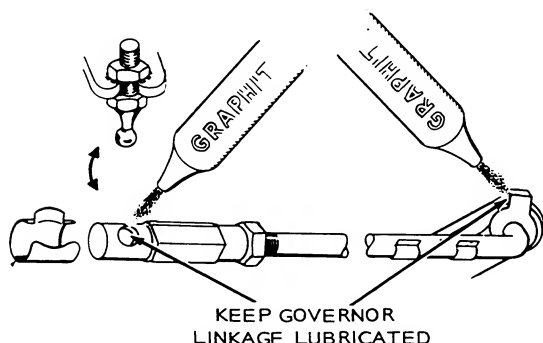


FIGURE 21. GOVERNOR LINKAGE

SPARK PLUGS

A spark plug with heavy combustion deposits can cause misfiring, poor operation, or stopping when a load is applied. Each time the spark plugs are removed, inspect, and regap (Figure 22). If a plug looks discolored or fouled, replace it.

- Black deposits indicate a rich mixture.
- Wet plug indicates misfiring.
- Badly or frequently fouled plug indicates the need for a major tune-up.

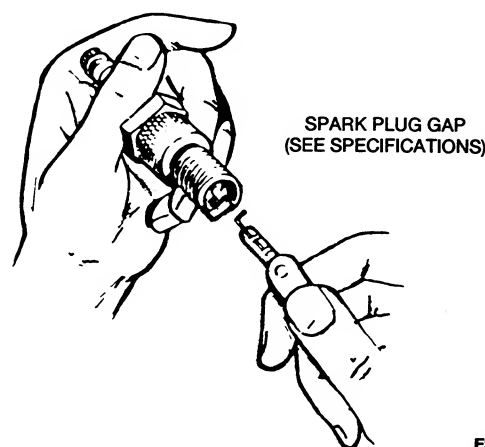


FIGURE 22. SETTING SPARK PLUG GAP

⚠ WARNING Do not clean spark plug by sandblasting. Deposits remaining on the plug can cause premature engine wear.

BREAKER POINTS

The *Specifications* section lists the correct breaker point gap for your model. To adjust the setting, use the following procedure.

1. Remove the starting battery negative (-) cable for the generator set.
2. Remove the two screws and the cover on the breaker box.
3. Remove the two spark plugs so engine can be easily rotated by hand.
4. Turn flywheel in a clockwise direction approximately 1/4 turn after top center (TC).
5. To adjust gap, refer to Figure 23. Loosen screws (A) and turn cam (B) until point gap measures specified gap with a flat thickness gauge. Retighten screws (A) and recheck gap.

Make adjustments with the engine turned off and cold. Make sure the feeler gauge is clean and free of grease, oil, or dirt.

6. If points are slightly burned, dress smooth with a file or fine stone. If points appear to be burned and pitted, replace with a new set.
7. Replace spark plugs and breaker box cover.

The timing is adjusted during initial engine assembly and is fixed by the point gap adjustment. No other adjustment or alignment is necessary.

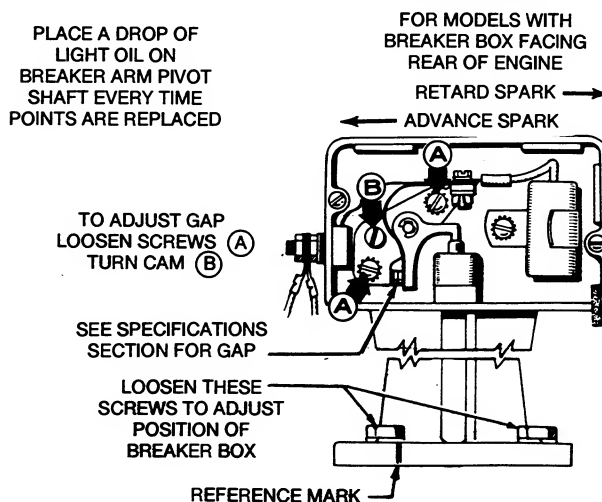


FIGURE 23. BREAKER POINTS

BATTERY CHECK

Check the specific gravity of the battery with a hydrometer. A fully charged battery provides a reading of 1.240 to 1.270 at 77°F (25°C). If one or more cells are low on water, add distilled water and recharge.

Keep the battery case clean and dry. An accumulation of moisture will lead to a more rapid discharge and battery failure.

Keep the battery terminals clean and tight. After making connections, coat the terminals with a light application of petroleum jelly or grease to retard corrosion.

GENERATOR MAINTENANCE

The generator normally needs little maintenance other than a yearly check of the brushes and collector rings by an authorized service center. If a major repair job on the generator should become necessary, the electrical equipment must be checked by a competent electrician who is thoroughly familiar with the operation of electric generators.

VACUUM SPEED BOOSTER

If there is tension on the external spring of the vacuum speed booster when the generator set is operating at no load or light load, it may be due to improper adjustment, a restricted hole in the small vacuum tube, or a leak in the booster diaphragm or gasket.

Use a fine wire to clean the small hole in the short vacuum tube which fits into the hole in the top of the engine intake manifold (Figure 24). Do not enlarge this hole.

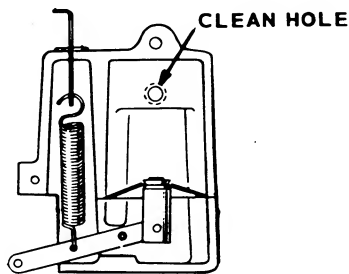


FIGURE 24. VACUUM SPEED BOOSTER

OUT-OF-SERVICE PROTECTION

Protect a unit that will be out of service for more than 6 months as follows:

1. Run the engine until it reaches normal operating temperature.
2. Turn off the fuel supply and run the engine until it stops.
3. Drain oil from oil base while the engine is still warm. Refill with fresh crankcase oil and attach a tag stating viscosity used.

▲WARNING *Hot oil can cause severe burns if spilled or splashed on skin. Keep fingers and hands clean when removing oil drain plug, and wear protective clothing.*

4. Remove spark plugs. Pour 1 ounce (2 tablespoons or 28 grams) of rust inhibitor or SAE #50 oil into the cylinders. Crank the engine over a few times. Reinstall spark plugs.
5. Service air cleaner as outlined in *Maintenance* section.
6. Clean governor linkage and protect by wrapping with a clean cloth.
7. Tie a plastic bag over the exhaust outlet to prevent entrance of moisture, dirt, bugs, etc.
8. Wipe entire generator set. Coat rustable parts with a light film of grease or oil.
9. Provide a suitable cover for the entire unit.
10. If battery equipped, disconnect battery and store in a cool dry place.

To Return to Service

1. Remove cover and all protective wrapping. Remove plug from exhaust outlet.
2. Check tag on oil base and verify that oil viscosity is still correct for existing ambient temperatures.
3. Clean and check battery. If the electrolyte level is low, add distilled water and charge. **DO NOT OVERCHARGE.**

▲WARNING *Ignition of explosive battery gases can cause severe personal injury. Do not smoke while servicing batteries.*

4. Check that fuel filter and fuel lines are secure, with no leaks. If any leaks are detected, have them corrected immediately. Replace worn fuel line components before leaks occur.

▲WARNING *Fuel presents the hazard of fire or explosion which can cause severe personal injury or death. Never fill the fuel tank when the engine is hot or running. Do not permit any flame, spark, pilot light, cigarette or other ignition source near the fuel system.*

5. Remove spark plug and crank engine to clear any remaining oil from the combustion chamber. Check spark plug gap and reinstall.
6. Connect battery and start engine. After engine has started, blue smoke is exhausted until the excess oil has burned away.
7. After starting, apply load to at least 50 percent of the maximum power output.
8. The generator set is ready for service.



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